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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/730,081 | 12/09/2003 | Su-Chen Lai | 0941-0873P | 2781 |
| 2292 | 7590 | 05/20/2005 | | EXAMINER |
| BIRCH STEWART KOLASCH & BIRCH PO BOX 747 FALLS CHURCH, VA 22040-0747 | | | | KENNEDY, JENNIFER M |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2812 | |

DATE MAILED: 05/20/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | |
|------------------------------|---------------------|--------------|
| Office Action Summary | Application No. | Applicant(s) |
| | 10/730,081 | LAI, SU-CHEN |
| | Examiner | Art Unit |
| | Jennifer M. Kennedy | 2812 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on 5/6/2005.
 2a) This action is FINAL. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1-11 is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
 5) Claim(s) _____ is/are allowed.
 6) Claim(s) 1-11 is/are rejected.
 7) Claim(s) _____ is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) Notice of References Cited (PTO-892)
 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
 Paper No(s)/Mail Date _____.

4) Interview Summary (PTO-413)
 Paper No(s)/Mail Date. _____.
 5) Notice of Informal Patent Application (PTO-152)
 6) Other: _____.

DETAILED ACTION

Notice to Applicant

Applicant's Amendment and Response to the Office Action mailed December 30, 2004 has been entered and made of record.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1 and 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Tews et al. (U.S. Patent Appl. 2003/0020110).

Tews et al. disclose a method for forming a bottle-shaped trench comprising the steps of:

providing a substrate (not labeled) having a pad structure (10) and at least one trench therein (see [0040] and Figure 2);

forming a mask layer (22) to fill the bottom of the trench;

etching the portion of the semiconductor substrate (see [0044]-[0048], see Figures 4 and 5) of the trench which is not covered by the mask layer, wherein the mask layer protects the bottom of the trench during the etching; and

removing the mask layer to form the bottle-shaped trench ([0050], see Figures 8, 9).

In re claim 10, Tews et al. disclose the method wherein the trench has a sidewall with a collar oxide layer at the top trench, and the semiconductor substrate unmasked by the collar oxide layer is etched in the trench (see [0048]-[0050] and Figures 8, 9).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tews et al. (U.S. Patent Appl. 2003/0020110) and Chen et al. (U.S. Patent No. 6,716,696) in view of Heo et al. (U.S. Patent No. 6,398,904).

In re claims 2-5, Tews et al. discloses the method of forming a bottle shaped trench in the substrate by the method of wet etching but does not disclose the method wherein the etching of the semiconductor substrate to form a bottle-shaped trench comprises the steps of: filling deionized water in the trench; and diffusing an etchant in the trench by means of the deionized water, thereby etching the semiconductor substrate not covered by the masking layer, and immersing the semiconductor substrate in the de-ionized water and immersing the semiconductor substrate in an etching solution containing the $\text{NH}_4\text{OH}+\text{H}_2\text{O}$ etchant to form the bottle shaped trench.

Chen et al. disclose the method of forming a bottle shaped trench including etching of the semiconductor substrate with diluted ammonia solution ($\text{NH}_4\text{OH}+\text{H}_2\text{O}$) to form a bottle-shaped trench comprises the steps of: filling water in the trench; and diffusing an etchant in the trench by means of water, thereby etching the semiconductor substrate not covered by a masking layer (see column 3, lines 40-45).

The examiner notes that ammonium hydroxide is an aqueous solution of ammonia, and synonyms for ammonium hydroxide are ammonia solution, and dilute ammonia. Chen et al. disclose an aqueous solution of ammonia that they refer to as diluted ammonia and water, and thus teach $\text{NH}_4\text{OH}+\text{H}_2\text{O}$.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize an ammonia solution and diffusing the etchant by means of water to form a bottle shaped trench in the method of Tews et al., because as Chen et al. teaches an ammonia solution and water is a suitable for selectively etching the substrate with a collar oxide acting as a mask, and allowing for etching in high aspect ratio vias, and since it has been held that the selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960).

Chen et al. does not disclose the use of deionized water or immersing the semiconductor substrate in the de-ionized water and immersing the semiconductor substrate in an etching solution containing the $\text{NH}_4\text{OH}+\text{H}_2\text{O}$ etchant

Heo et al. teach the use of deionized water and immersing the substrate into the deionized water and etchant (see column 3, lines 4-15). It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize deionized water and immerse the substrate into the tank in order to prevent contamination and allow for efficient and precise etching (see Heo et al. column 2, lines 35-42).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tews et al. (U.S. Patent Appl. 2003/0020110) in view of Chen et al. (U.S. Patent No. 6,716,696).

Tews et al. disclose the method as claimed and rejected above, but does not disclose the method wherein the pad structure comprises a stacked oxide layer and a nitride layer. Chen et al. disclose the method wherein the pad structure comprises a stacked oxide layer and a nitride layer (102, 104). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a layer of oxide intermediate the silicon nitride and the substrate to allow for adhesion of the silicon nitride on the silicon oxide.

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tews et al. (U.S. Patent Appl. 2003/0020110) in view of Schrems et al. (U.S. Patent No. 6,777,303).

In re claim 7, Tews et al. disclose the method as claimed and rejected above, including forming the masking layer of polysilicon, but does not disclose the method wherein the masking material is photoresist. Schrems et al. disclose the method wherein the masking layer can be either polysilicon or photoresist (see column 5, lines 1-10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize photoresist as the masking layer in Tews et al. because as Schrems et al. teach, photoresist and polysilicon are interchangeable in the art of trench capacitors as masking layers, and because the photoresist would allow for selective etching the substrate, and since it has been held that the selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960).

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tews et al. (U.S. Patent Appl. 2003/0020110) in view of Wurster et al. (U.S. Patent No. 6,828,191).

Tews et al. disclose the method as claimed and rejected above, including the method of recessing the masking material to a predetermined depth thus forming a mask layer in the trench, but do not disclose the method wherein the filling of the mask layer in the trench comprises coating the pad structure with a masking material to fill the trench.

Wurster et al. disclose the method wherein the filling of the mask layer in the trench comprises coating the pad structure with a masking material to fill the trench (see column 6, lines 22-35). It would have been obvious to one of ordinary skill in the art at the time the invention was made to fill the mask layer including coating the pad structure with a masking material in order to ensure complete filling of the trench without voids and allow for subsequent planarization.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tews et al. (U.S. Patent Appl. 2003/0020110) and Wurster et al. (U.S. Patent No. 6,828,191), in view of Schrems et al. (U.S. Patent No. 6,777,303).

In re claim 9, Tews et al. and Wurster et al. disclose the method as claimed and rejected above, including forming the masking layer of polysilicon, but does not disclose the method wherein the masking material is removed with a solution comprising a mixture of H_2SO_4 and Hydrogen Peroxide photoresist. Schrems et al. disclose the method wherein the masking layer can be either polysilicon or photoresist, and further disclose that when utilizing photoresist as the masking layer the photoresist masking material is removed with a solution comprising a mixture of H_2SO_4 and Hydrogen Peroxide (see Schrems et al. column 5, lines 1-10 and column 6, lines 20-35). It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize photoresist as the masking layer, and remove the photoresist masking layer with a solution comprising a mixture of H_2SO_4 and Hydrogen Peroxide in Tews et al. because as Schrems et al. teach, photoresist and polysilicon are interchangeable in the

art of trench capacitors as masking layers, and the solution of a mixture of H₂SO₄ and Hydrogen Peroxide are suitable for removing the photoresist from the trench, because the photoresist would allow for selective etching the substrate, and the solution of H₂SO₄ and Hydrogen Peroxide is effective to selectively remove unwanted photoresist after processing, and further, since it has been held that the selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960).

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tews et al. (U.S. Patent Appl. 2003/00204110).

In re claim 11, Tews et al. disclose the method as claimed and rejected above, including the method of a poly recess that is affected to obtain a depth about the (STI) level 23 at about 500nm (see [0040]), but does not disclose the method wherein the depth of the mask layer is defined to about 600nm from the top of the trench. The examiner notes that Applicant does not teach that the depth from the top of the trench solve any stated problem or is for any particular purpose. Therefore, the depth lacks criticality in the claimed invention and does not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the resist at any depth from the top of the trench, since the invention would perform equally well when the mask is at different depths to protect the

bottom of the trench from etching, and because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233, MPEP 2144.05 II A. Further, the examiner notes that the depth from the top of the trench would be dependent on the total depth of the trench and could be optimized.

Response to Arguments

Applicant's arguments with respect to claims 1-11 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Muller et al. (U.S. Patent No. 5,776,808) disclose the use of a pad oxide between the substrate and the pad nitride to allow for better adhesion.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Kennedy whose telephone number is (571) 272-1672. The examiner can normally be reached on Mon.-Fri. 9:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael S. Lebentritt can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Jennifer M. Kennedy
Patent Examiner
Art Unit 2812

jmk